

# UK Technical Advisory Group on the Water Framework Directive

## Draft Protocol for determining “Significant Damage” to a “Groundwater Dependent Terrestrial Ecosystem”

This Guidance Paper is a working draft defined by the UKTAG. It documents the principles to be adopted by agencies responsible for implementing the Water Framework Directive (WFD) in the UK. The paper provides an initial framework, but detailed research over the next 2-3 years will be required for its complete application throughout the UK and RoI.

<b>Working Paper</b>	Version 9.6 04-10-05	<b>Status:</b>	Approved UKTAG Sept-05 , released 12/05
<b>Version:</b>		<b>UKTAG</b>	
<b>WFD Requirement:</b>	Article 4, Annex 5 of WFD, GWDTE, Wetlands, Groundwater, Significant Damage	<b>Review:</b>	WTT/GWTT/UKTAG

### 1. Purpose

- 1.1 This paper sets out UKTAG’s guidance on a risk-based decision pathway for the determination of “significant damage” to Groundwater Dependent Terrestrial Ecosystems (GWDTEs). It will support consistent decision-making by using conceptual models and other tools to determine:
- Quantitative or qualitative thresholds for groundwater resource and quality pressures (e.g. phosphate levels, salinity, ochre etc) on a wetland type or site specific basis;
  - The likelihood of achieving environmental objectives for sites containing GWDTE, where applicable (i.e. statutory sites) based on Common Standards monitoring (as defined by the Joint Nature Conservation Committee).
- 1.2 In this guidance, GWDTEs refers specifically to those wetlands identified as being directly dependent on groundwater bodies according to the methods and UK National Vegetation Classification (NVC) communities listed in Annex 1 of UKTAG Guidance: *TAG (2004) 5a-b Guidance on the identification and risk assessment of groundwater dependent terrestrial ecosystems* (in short known as *TAG (2004) Guidance 5a-b*). The habitats considered include terrestrial wetlands including mires, swamps, wet grassland, heathland and woodland, wet dune slacks and machair.
- 1.3 The protocol is designed for use on any wetland. The outcome of the process is to have identified the wetlands on a country basis where significant damage or likelihood of significant damage is confirmed or suspected with a level of certainty. Actions to be taken as a result of identifying significant damage will be determined under a separate process at a country level. This may include action undertaken within the programme of measures or under other processes (e.g. design guidelines for activities adjacent to wetlands, or land-use planning processes).
- 1.4 This guidance sets the framework for *what* will be done, but not *how* to do it in detail. Detailed methods and thresholds will be developed through the *ongoing research programmes* in the United Kingdom (UK) and Republic of Ireland (RoI).

### 2. Principles

- 2.1 Appropriate understanding of sites, pressures and solutions needs to be developed by Ecologists and Hydrogeologists **working closely together** from the start of the process, and at every stage. It is preferred for ecologists to lead in the early stages and direct the hydrogeologists to the critical conservation features for risk assessment, where possible.

## TAG (2005) Criteria for determining significant damage

- 2.2 Given the lack of existing data, the determination of significant damage will use technical assessments backed up by **expert judgement** where necessary. (Note it is recognised that the situation will improve under ongoing research programmes across the UK and RoI commencing in 2005/06).
- 2.3 Conservation and environment agencies need to work together to develop an understanding of how sites work and to what pressures they are vulnerable.
- 2.4 Conservation and environment agencies will use and develop existing tools where appropriate for understanding wetland water supply mechanisms (e.g. WETMECS) and tolerance ranges of plant communities (eco-hydrological guidelines). Ongoing research programmes across the UK and RoI will consider the applicability of extending these tools geographically and to other habitats for which guidelines are not currently available.
- 2.5 The Water Framework Directive's (WFD) requirements and interpretation relating to GWDTEs are outlined for reference in Annex 2, including links to other UK TAG Guidance.
- 2.6 The determination of groundwater body status under the WFD requires only chemical and quantitative monitoring. There is no specific requirement for biological monitoring of GWDTEs in order to determine the status of the groundwater body. However, the assessment of this biological data is necessary to identify whether significant damage is occurring, or likely to occur, due to existing pressures.
- 2.7 If a groundwater resource or chemical pressure is causing, (or likely to cause), 'significant damage' to dependent terrestrial ecosystems, then the groundwater body is not in "good status". The term "significant damage" has been described in *TAG (2004) Guidance 5a-b* as a function of:
- a) '**degree of damage**' occurring to a GWDTE (caused by groundwater related factors); and
  - b) the '**significance**' or '**conservation value**' of the ecosystem.
- 2.8 In some parts of the UK, specific legislation has developed principles to assess environmental damage (e.g. Water Act 2003 in England and Wales) or have requirements for wetlands management (Water Environment and Water Services (Scotland) Act in Scotland). This guidance will need to be interpreted by the different countries in the light of different policy and legislative drivers. The RoI will adopt the principles of the guidance, however, due to a different system for site notifications (there is no equivalent of the UK non-statutory sites), it will require modification to become formally adopted in RoI.
- 2.9 Assessment of groundwater related factors causing significant damage will include:
- a) the degree of sensitivity of the wetland to changes in groundwater related factors;
    - for groundwater resource pressures, consider the ultimate extent of the cone of depression due to that pressure. For example, drawdown due to a groundwater abstraction will continue to spread. And it will only stop spreading when the drawdown reaches and induces extra leakage from rivers, lakes or wetlands, or when it reduces discharges to rivers, lakes, springs or wetlands, sufficient to balance the abstraction rate (Theis, 1940)<sup>1</sup>. Note that the cone of depression may cross groundwater divides, hence groundwater resources pressures may affect a wetland even if they do not originate in the catchment area or capture zone of the wetland;
    - for chemical pressures **only**, consider whether these pressures occur in the capture zone of the wetland;
  - b) the presence of a susceptible pathway between the relevant pressure and the wetland; and

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<sup>1</sup> Theis C V, 1940. *The source of water derived from wells: essential factors controlling the response of an aquifer to development*. Civil Eng. Vol 10 No. 5, pp277-280.

## TAG (2005) Criteria for determining significant damage

- c) whether groundwater monitoring exists and confirms the transmission of the effects of the pressure via the pathway to the wetland.
- 2.10 Groundwater is slow to move and ecological impacts may take a considerable time to become evident. Therefore, a wetland may need to be assessed as significantly damaged due to existing groundwater pressures in advance of actual damage to ecological integrity.
- 2.11 A risk-based approach will be applied to the identification of significant damage based upon:
  - a) conservation significance of the GWDTE;
  - b) available knowledge/evidence and its interpretation from predictive modelling and
  - c) the known or anticipated degree of impact on ecological integrity.
- 2.12 The “Degree of damage” on a statutory designated site should be judged as “significant” when any groundwater-dependent ecosystem for which the site is designated is judged as being in “unfavourable condition”, or is failing, or at risk of failing to meet its conservation objectives **because of changes induced by groundwater quality or quantity pressures**.
- 2.13 The fact that a GWDTE is failing to meet its conservation objectives for reasons directly related to changes induced by groundwater quality or quantity pressures should be proof enough of “significant damage”. In most cases, we know very little about how permanent such damage may be. A key determinant of this will be the proximity of related habitats and their role as a source of re-colonising material (seeds etc.). As so many of our wetlands are so fragmented, even moderate damage leading to the loss of a very few species could now be irreversible.
- 2.14 In the UK, non-statutory sites should be judged as significantly damaged if any groundwater-dependent ecosystem which is a UK Biodiversity Action Plan, (UK BAP), priority habitat is judged as damaged or declining **for reasons of inadequate groundwater quality or quantity**.
- 2.15 Understanding of the **eco-hydrological functioning** of wetland systems requires conceptual understanding and generic water, nutrient and management regimes for wetland vegetation communities. Conceptual models for wetlands have been developed in several recent studies. Ongoing research programmes across the UK and RoI will draw these studies together into a wetland manual to guide practitioners (see section 4). Examples are located in a separate case studies document.
- 2.16 Several different eco-hydrological conceptual models may be applied at a **sub-site scale** as part of developing conceptual understanding of the whole site. This is due to cross-site variability in water supply mechanisms, for example the centre of a raised bog may be rainfall-dependent, whereas the ecology of the margins may be dependent on groundwater or a mixture of waters.

## 3 Risk-Based Approach to Determining Significant Damage

- 3.1 In this section a tiered, risk-based approach to determination of significant damage is outlined, consistent with UK Government requirements. Annex 1 provides the flowchart of the process, using a three stage risk assessment to give a clear structure to the tasks. This is based on the Defra/Environment Agency model of risk assessment.

Note: The structure as outlined can also be used to draw on and combine assessments required under the Habitats Directive and other legislation.

- 3.2 A tiered approach to risk assessment for establishing significant damage contains the following stages:
  - Tier 1 – Risk screening
  - Tier 2 – Quantitative assessment
  - Tier 3 – Detailed assessment

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Several steps need to be repeated at each tier; these are described below and summarised in the flowchart (Annex 1). Each successive tier makes an impact assessment based on progressively more detailed investigation, leading to increased confidence. Early tiers will use readily available desk-based information, whilst subsequent tiers may require field investigation and/or use of predictive quantitative models. The initial screening process is likely to be the most demanding in terms of expertise, since specialists will be expected to make judgements on minimal information.

The procedure will need to be adapted within the countries according to their existing procedures, available data and information. The tiers may be subdivided to provide further structure to investigations.

- 3.3 Through this process, ecological and hydrogeological components will be integrated in recognition that ecology drives judgements of significance, groundwater dependency and damage. Without ecological information, some screening may be based only upon hydrological information. However, it is unlikely that this will influence the assessment of groundwater body status unless the perceived risk is believed to be significant. The method of hydrogeological assessment will be tailored depending on the sensitivity of the habitats and plant communities present.

**Steps in assessing the risk of significant damage should include:** (Section 1.4 states that this guidance deals with 'what' not 'how' significant damage is assessed. Hence these steps are not in any intended order).

1) *Ranking*

- Method to prioritise the sites so that they can be assessed for significant damage in order of importance (see Table 1)

2) *Screening*

- Method to screen out water dependent terrestrial ecosystems that are definitely **not** at risk of significant damage. For example this could be because there are no significant pressures, there are no significant groundwater interactions (pathways) or the wetland ecology is not sensitive to changes in groundwater quantity or quality.
- Method to screen out water dependent terrestrial ecosystems which are definitely significantly damaged due to groundwater pressures

3) *Assessment of significant damage*

- Identify/predict risk of hydrological impact due to groundwater quantity or quality pressures and pathways.
- Identify eco-hydrological requirements of the wetland ecosystems
- Assess significance of groundwater quantity and quality impacts based on eco-hydrological requirements.

4) *Risk characterisation (uncertainty)*

- Is the ecology of the site likely to be damaged?
- Is the risk likely to be significant to the integrity of the ecological features?
- What further critical investigations are required?
- Is there sufficient confidence in the assessment at this tier?

### Burden of proof supporting risk assessments

- 3.4 The separate requirements for Protected Areas (Natura 2000 Sites) and Groundwater Body status classification Sites of Special Scientific Interest/ Area of Special Scientific Interest (Northern Ireland)/UK BAP Priority Sites, (SSSI/ASSI/UK BAP) carry different burdens of proof – for **Protected Areas** a precautionary “no risk” approach is taken.
- 3.5 For both Protected Areas and groundwater status assessments, a precautionary judgement of the risk of significant damage should be made based upon the hydrological impact assessment, **before** ecological evidence of damage becomes apparent.
- 3.6 **Groundwater Body classification** is evidence-based as the WFD requires us to use monitoring in assessing status. For determination of significant damage at GWDTEs this means assessment of both quantitative and ecological data – (see 2.6):

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- For Protected Areas (Natura 2000 sites), we will use assessments made under the Habitats Directive to support the significant damage assessments. These use a more precautionary staged approach. For a groundwater body to be assessed as at poor status, there must be strong consensus that there is the potential for damage to be caused by groundwater pressures. Based on *Protected Area objectives* a conclusion *may* be made after the first step in the risk assessment based on high risk of damage, even if there is no current evidence of damage.
- For all other sites (SSSI/ASSI/UK BAP Priority Sites)  
Based on *groundwater status objectives*, the judgement of significant damage must be based upon evidence of damage or high risk that damage will occur if no action is taken.

**Prioritising sites to be assessed for groundwater dependence and significant damage**

- 3.7 TAG (2004) *Guidance 5a-b* describes the process for identification of GWDTEs. Therefore the starting point for further characterisation will include any lists:
- a) prepared for Initial Characterisation Article V reporting; and/or
  - b) of water-dependent conservation sites as developed under country-specific legislation
- 3.8 Prioritisation of sites for determination of significant damage is to be undertaken by individual environment and conservation agencies following the principles given below. UKTAG *Guidance (2004) 5a-b* (paragraph 7.2) lists the types of site to be included. Annex 2 of this paper gives further clarification on nationally important non-statutory sites.
- 3.9 Prioritisation should ensure that investigation is undertaken to an appropriate level and focuses our work on the most relevant areas. This requires an agreed method of prioritisation to focus our work on those sites where programmes of measures may be required first, and those where the objectives are more stringent, making conceptual understanding a priority. Each site should be given a ranking based upon Table 1. Table 1 does not include:
- Sites which are definitely damaged and groundwater is known to be the cause. These would not need to go through the entire process, but would be reported through the further groundwater characterisation process.
  - Sites which are definitely not damaged and not subject to groundwater pressures.

For some sites, we may not be sure because we do not know whether they are groundwater-dependent, or whether they are subject to any groundwater-related pressures. These sites will require further investigation.

**Table 1: Prioritisation of Significant Damage assessments**

Conservation Designation	Priority Ranking			
	Damaged (cause unknown)	Maybe Damaged (cause unknown)	Not Damaged (groundwater dependent & groundwater pressures)	Not Damaged (water source unknown, groundwater pressures)
International SAC or SPA	1	2	5	6
National statutory SSSI/ASSI	3	4	7	8
National non-statutory UK BAP priority	9	10	11	12

**Note:** this table is intended as a guide only – each country will prioritise according to local need and site notification systems (e.g. non-statutory sites are not recognised in the RoI). There may, for example, be a proven need to deal with a specific non-statutory site first e.g. if it is known to be damaged.

## **TAG (2005) Criteria for determining significant damage**

### **Carrying out Tier 1 Assessment - Risk Screening**

- 3.10 The purpose of screening is to focus on GWDTEs identified as at risk. This work is carried out at a national scale, and is focussed on screening out sites where there is high confidence of either:
- minimal linkage, minimal damage and/or minimal pressure or
  - high groundwater dependence and damage directly caused by groundwater pressures
- 3.11 Screening of individual sites should begin with the most likely habitats and the most sensitive plant communities first, using desk-based evidence backed up by expert opinion where there is incomplete knowledge and lack of tools for impact assessment. Annex 3 contains links to generic habitat and species information for European conservation interest features.
- 3.12 Confidence in the assessment should normally be established based on monitoring of the site. The principles for determining groundwater monitoring requirements outlined in UKTAG paper 12a Chapter 2 must be adhered to. For example, in some cases confidence may be sufficient without site-specific monitoring, instead using grouped monitoring, or establishing that the pressure is not sufficient to cause damage, or the pathway does not allow transmission of the pressure.
- 3.13 For sites where investigation monitoring is required to determine significant damage, a generic checklist for receptor-focussed groundwater monitoring of GWDTEs is provided in Annex 4 recognising:
- the most cost effective form of site investigation is joint site visits between hydrogeologists and ecologists.
  - where statutory objectives exist, all sites on the finalised GWDTE list will require programmed ecological monitoring to confirm their condition and allow an assessment of “significant damage” to be made.
  - the design of hydrometric monitoring should be determined on a site by site basis.
  - additional monitoring may be required in future at Natura 2000 sites if deemed to be significantly damaged (e.g. from diffuse pollution).
- 3.14 Assess the groundwater dependency of the site, taking into account different eco-hydrological functioning of different parts of the site. Generic conceptual models will help, but it may also be necessary to consult an ecologist with specific expertise in the site or the type of habitats present.

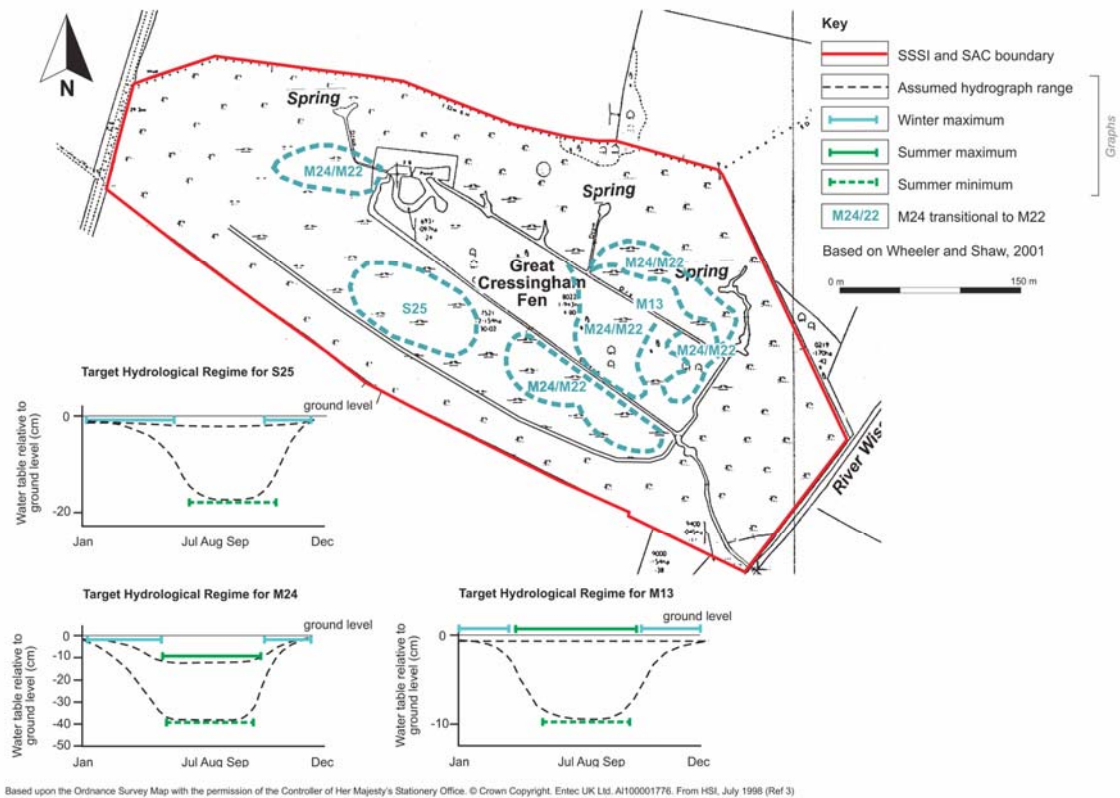
### **Establishing required eco-hydrological regimes**

- 3.15 Establishing ecological effect resulting from groundwater pressures requires:
- Quantification of the impact upon the hydrological or hydrochemical regime, and
  - Establishing whether wetland plant communities exhibit a response to the particular hydrological or hydrochemical change involved.

Note: It is recognised that the lack of good quality time-series data of shallow groundwater levels and water quality for wetland sites across the UK may hinder the precise definition of eco-hydrological requirements. It is anticipated that this will improve over the river basin planning cycles.

- 3.16 The location of features and their associated hydrological targets should be shown on a map (Figure 2 provides an example).

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**Figure 2** Example of European Feature Communities and Associated Target Hydrological Regimes

### Is the site at risk of significant damage?

- 3.17 Following tier 1 assessment, Specialists within the conservation and environmental agencies will make a risk-based judgement concluding either that the site is “significantly damaged”, “probably” or “at risk of being” significantly damaged, or “not significantly damaged”.
- 3.18 If the Specialists are unable to reach a decision on a specific site, they should refer to ecologists and hydrogeologists with local knowledge or expertise. Local expertise should always be used to quality control the significant damage assessments.
- 3.19 The output of initial screening is a list of pressures which may be causing significant damage to the integrity of the GWDTE.

### Drawing conclusions and inputting results to the groundwater body classification process

- 3.20 If the risk in the decision made during the Tier 1 assessment is acceptable, then conclusions should be written up and results input to the groundwater body classification process. The flowcharts 1-5 in UKTAG paper 11b should be referred to during recording of the results of the assessment.
- 3.21 Sites judged as “significantly damaged” or “at risk of being significantly damaged” will require a Tier 2 generic quantitative risk assessment where there is insufficient confidence in the Tier 1 assessment.
- 3.22 The results will inform the groundwater body classification process, ongoing further characterisation and development of the Programmes of Measures.

## 4 Future Research to support implementation of the risk assessment protocol

- 4.1 UK TAG Wetland/Groundwater Task Teams has identified under its proposed research framework, the need for:

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- 1) Guidance to support characterisation of groundwater requirements and relationships associated with sustaining NVC communities (short-medium term), and
  - 2) Building knowledge base on groundwater/wetlands interactions (long-term research development)
- 4.2 Priority 1 is to be investigated during 2005 under SNIFFER project WFD62 (Wetland and Groundwater Interactions). Other projects developing conceptual models relevant to the determination of significant damage are in progress across the UK and RoI and will be drawn together into a wetland manual.
- 4.3 Priority 2 requires further development of monitoring carried out by the conservation and environment agencies. This includes for example:
- considering the wider application of ecological monitoring methodology of Wheeler, Shaw and Hodgson (1999)<sup>2</sup> to detect the cause of damage;
  - SNIFFER project WFD66 "Characterisation of Scottish Wetlands" is to deliver a Scottish inventory of wetlands that are directly dependent on groundwater and surface water. This is important to enable the first step in the protocol for significant damage to be undertaken ("agree sites to be assessed for groundwater dependence and significant damage").
- 4.5 Table 2 below highlights methodological or data gaps where existing knowledge or monitoring systems may be limited for use when undertaking an assessment of significant damage.

**Table 2: Methodological and data gaps**

Assessment and monitoring systems	Limitation	Proposed response at UK/country level
Groundwater pressure assessment	There may be lack of knowledge as to whether the changes arise from natural variability in groundwater flows and quality. Dependency of wetland upon groundwater.	Build predictive modelling capability that supports risk based analysis on factors contributing to the likelihood of significant damage
	Groundwater monitoring tends to be focused on pressure-specific problems, such as amount of the water resource abstracted, salinity changes or pollutants entering the groundwater. There does not tend to be a link to identifying the consequences to ecosystem health.	Review monitoring regimes with focus on strategic monitoring linked to receptor (GWDTEs) health.
Condition assessments of conservation sites	Does NOT monitor elements that specifically allow the determination of hydrological or physico/chemical problems associated with groundwater.	Review existing data collection systems and identify factors that support such judgements
Quantitative thresholds for significant damage	There is a lack of guidance as to the thresholds that may be related to changes in groundwater dependant National Vegetation Classification (NVC) communities from groundwater related pressures.	Short-term: review existing data from systems like WETMECS and develop initial guidance on thresholds.
	These thresholds must relate to favourable condition objectives identifying: <ul style="list-style-type: none"> <li>○ acceptable seasonal regimes (water levels, water quality, management) for habitats, which do not lead to long-term deterioration</li> <li>○ acceptable level of variability/condition of NVC plant communities within the GWDTE</li> <li>○ the spatial extent of the GWDTE that must be maintained over time</li> </ul>	Long-term: initiate R&D project/s to identify receptor sensitivity thresholds and optimum water level/quality regimes.

<sup>2</sup> Wheeler, B.D., Shaw, S.C., and Hodgson, 1999. *A monitoring methodology for wetlands*. Report to Environment Agency, Anglian region



## Annex 1 Proposed Method for Determining Significant Damage to a Groundwater Dependent Terrestrial Ecosystem under the WFD

<b>Number:</b>		<b>Status:</b>	Final Draft	<b>Issue Date:</b>	08/09/05	<b>Review Due:</b>	
<b>Procedure Owner:</b>				<b>Post:</b>			
<b>Procedure Author:</b>		Mark Whiteman		<b>Post:</b>		Technical Adviser 1	
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				<b>Post:</b>		Technical Adviser 1	
						(Hydrogeology)	

<b>Purpose:</b>	For the determination of significant damage to groundwater-dependent terrestrial ecosystems as required by the Water Framework Directive (2000/60/EC)
<b>Success Criteria:</b>	<ul style="list-style-type: none"> <li>That conclusions are drawn relating to significant damage for all relevant groundwater-dependent terrestrial ecosystems to an agreed process and timescale</li> <li>That results are input to the groundwater body classification process.</li> </ul>
<b>Scope:</b>	<p>To detail the full procedure for determination of significant damage to groundwater-dependent terrestrial ecosystems.</p> <p>This is for use by environment and conservation agencies in the UK and RoI.</p>

Who	Activity	Steps	References/links
<p><b>Conservation Agencies</b> in consultation with <b>Regulatory Agencies</b></p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Prioritising sites to be assessed for groundwater dependence and significant damage</b></p> </div> <div style="text-align: center; margin: 10px 0;"> </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Carrying out Tier 1 Risk Assessment (Risk Screening)</b></p> </div>	<ul style="list-style-type: none"> <li>⇒ Prepare database of water-dependent conservation sites (SAC/SPA, SSSI/ASSI and BAP priority habitats)</li> <li>⇒ Supply supporting evidence where available, for example sites where there is evidence of damage and/or damage could be due to abstraction or quality pressure.</li> <li>⇒ Prioritise significant damage assessments based upon the conservation value, and degree of damage occurring to the GWDTE using table 1 in Guidance</li> <li>⇒ Identify location and extent of conservation features.</li> <li>⇒</li> </ul>	<ul style="list-style-type: none"> <li>• UK TAG paper 5a</li> <li>• Site Notification database (e.g. English Nature ENSIS)</li> <li>• Conservation objectives and favourable condition tables for site from Conservation Agencies</li> <li>• Damage monitoring</li> <li>• SNIFFER WFD66 characterisation of Scottish Wetlands</li> <li>• Site citations</li> <li>• NVC surveys</li> <li>• Remote sensing</li> <li>• SNIFFER WFD66</li> <li>• Digital site survey data</li> </ul> <p>Where data is not available, expert opinion on the identity of plant communities will be required.</p>
<p>Conservation Agencies</p>			

Who	Activity	Steps	References/links
<p><b>Regulatory Agencies</b> Specialists working closely with Conservation Agencies</p>		<ul style="list-style-type: none"> <li>⇒ <b>Assess the degree of groundwater dependence using both biological and hydrogeological factors</b></li> <li>⇒ Establish eco-hydrological functioning of the wetland starting with existing generic conceptual models</li> <li>⇒ Identify key sensitivities of the conservation features</li> <li>⇒ Identify sites that are definitely groundwater dependent due to type of conservation features or because there are no surface water inputs to the conservation features concerned.</li> <li>⇒ Groundwater pressures and pathway databases – possible/probable risk.</li> <li>⇒ Combine pressures with damage from prioritisation step above</li> <li>⇒ <b>Establish from pressures databases if there is any evidence of significant impact or high risk of significant impact</b> based upon the scale of impact or exposure pressure.</li> </ul>	<p>All the above plus</p> <ul style="list-style-type: none"> <li>• WFD River Basin Characterisation maps</li> <li>• UKTAG Paper 11b</li> <li>• Habitats Directive Guidance</li> <li>• Soil maps and data</li> <li>• British Geological Survey GeoSure</li> <li>• Geological maps</li> </ul>
<p>Regulatory Agencies</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p><b>Is the site at risk of significant damage?</b></p> </div> <p style="text-align: center;">Yes or maybe      No</p>	<ul style="list-style-type: none"> <li>⇒ Conclude “no significant damage” or “possible significant damage” or “significant damage”</li> <li>⇒ Is there a risk to a Protected Area based on hydrological impact assessment?</li> <li>⇒ Establish the level of confidence in assessment (is the risk in this decision acceptable?)</li> <li>⇒ If not damaged then surveillance monitoring adequate</li> <li>⇒ If at risk/maybe, identify further investigation work</li> <li>⇒ Quality review by ecologists and hydrogeologists with local knowledge</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
<p>Regulatory Agency Specialists</p>	<div style="border: 1px solid black; padding: 5px;"> <p>Draw conclusions and input results to groundwater body classification process</p> </div>	<ul style="list-style-type: none"> <li>⇒ Report outcome of risk assessment using flowcharts 1-5 in UKTAG paper 11b</li> <li>⇒ Inform groundwater body classification</li> <li>⇒ Inform development of Programme of Measures</li> <li>⇒ Inform further characterisation</li> </ul>	<ul style="list-style-type: none"> <li>• UKTAG paper 11b</li> </ul>

Who	Activity	Steps	References/links
Regulatory Agency Specialists working closely with Conservation Agencies	<p><b>Carry out Tier 2 Generic Quantitative Risk Assessment</b></p>	<p>Using local knowledge to enhance information from Tier 1</p> <p>Investigate for evidence that the significant impact is a result (wholly or partly) of groundwater abstraction or groundwater pollution</p> <ul style="list-style-type: none"> <li>• Establish required eco-hydrological regimes for site</li> <li>• Identify alternative conceptual models</li> <li>• Refine knowledge of pressures and impacts</li> <li>• Review hydrological prediction of damage (from pressures)</li> </ul>	<ul style="list-style-type: none"> <li>• Wetland ecohydrological conceptual models</li> <li>• Ecohydrological regime Guidelines (where available /applicable)</li> <li>• SNIFFER WFD62 Wetland and Groundwater Interactions</li> </ul>
Regulatory Agencies	<p><b>Is the site at risk of significant damage?</b></p> <p>Yes or maybe</p> <p>No</p>	<p>⇒ Conclude “no significant damage”, “possible significant damage” or “significant damage”</p> <p>⇒ Is there a risk to a Protected Area based on hydrological impact assessment?</p> <p>⇒ Is there evidence of damage (or high risk) to other GWDTE?</p> <p>⇒ Establish the level of confidence in assessment (is the risk in this decision acceptable?)</p>	<ul style="list-style-type: none"> <li>• UKTAG paper 11b</li> </ul>
Regulatory Agency Specialists	<p>Draw conclusions and input results to groundwater body classification process</p>	<p>⇒ Report outcome of risk assessment using flowcharts 1-5 in UKTAG paper 11b</p> <p>⇒ Inform groundwater body classification</p> <p>⇒ Inform development of Programme of Measures</p> <p>⇒ Inform further characterisation</p>	
Regulatory Agency Specialists working closely with Conservation Agencies	<p><b>Carry out Tier 3 Generic Quantitative Risk Assessment</b></p>	<p>Using detailed quantitative assessment: to enhance information from Tiers 1 &amp; 2</p> <p>Refine confidence in the cause and effect of damage</p> <p>Investigate for evidence that the significant impact is a result (wholly or partly) of groundwater abstraction or groundwater pollution</p>	<p>As above for Tier 2</p>
Regulatory Agency Specialists	<p>Draw conclusions and input results to groundwater body classification process</p>	<p>⇒ Report outcome of risk assessment using flowcharts 1-5 in UKTAG paper 11b</p> <p>⇒ Inform groundwater body classification</p> <p>⇒ Inform development of Programme of Measures</p> <p>⇒ Inform further characterisation</p>	<ul style="list-style-type: none"> <li>• UKTAG paper 11b</li> </ul>

Related Documents:	<ul style="list-style-type: none"><li>• SNIFFER WFD53 Criteria for WFD Groundwater Good Quantitative Status</li><li>• Common Implementation Strategy for the Water Framework Directive (2000/60/EC) Wetlands Horizontal Guidance 17 December 2003</li><li>• UKTAG Paper 5a Guidance on the identification and risk assessment of groundwater dependent terrestrial ecosystems</li><li>• UKTAG Paper 7(l) Guidance on Pollution Pressures on groundwater</li><li>• UKTAG Paper 11b Outline of groundwater classification for the purposes of the Water Framework Directive</li><li>• <i>Local Impact assessment of wetlands - from hydrological impact to ecological effects</i>, Whiteman M, Jose P, Grout M, Brooks A, Quinn S and Acreman A, published in <i>Hydrology: Science &amp; Practice for the 21<sup>st</sup> Century - Volume II</i>, British Hydrological Society (2004)</li></ul>
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## Annex 2: The Directive's requirements and its interpretation

- A1.1 GWDTE are brought into the scope of the WFD via the requirement to achieve good status for groundwater bodies (both quantitative and chemical) in Article 4.1(b) of the Directive. Via Annex V, section 2 of the WFD 'Good Groundwater Status' is dependent upon there being no 'significant damage' to GWDTE caused by alterations to either the flow of groundwater, or the concentrations of any pollutants in groundwater bodies resulting from human activities. The causal factor responsible for altering the groundwater quality or quantity which then impacts on the GWDTE may range from a specific activity, (e.g. borehole abstraction), to a wider scale impact (e.g. diffuse pollution). This may detrimentally affect the groundwater chemistry which impacts on the GWDTE.
- A1.2 UKTAG guidance defines a Groundwater Dependent Terrestrial Ecosystem (GWDTE) as: **"A terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in, or flow of, water from a groundwater body (that is, in or from the saturated zone)."** The health of such an ecosystem may also depend on the concentrations of substances, (and potential pollutants), within that groundwater body, but there must be a direct hydraulic connection with the groundwater body. (UKTAG Guidance WP 5a-b (01) *Guidance on the identification and risk assessment of groundwater dependent terrestrial ecosystems.*)
- A1.3 The definition of **significance** has been addressed in UKTAG Guidance 5a-b. In summary, the UK conservation designation system is used as surrogates for determining where ecosystems of *significance* occur. This is based upon conservation value, as determined by rarity, naturalness, typicalness, restoration value, etc.

*Note. The non-statutory system (i.e. UK BAP habitats and sites of local importance) is based upon a combination of conservation value and other factors such as proximity to population, educational opportunity, degree of threat and ecosystem services. The process of identification of statutory and non-statutory sites is not yet complete, with many sites waiting formal registration, especially in Wales, Scotland and Northern Ireland. There is no system of non-statutory sites or sites of local importance in RoI.*

- A1.4 There may be overlapping but separate obligations with respect to Article 4 (1c) for Protected Areas of the Directive, to ensure that "any standards and objectives" required by the relevant legislation under which the protected areas are designated are achieved by 2015.

### A2.0 Principles underlying the determination of Significant Damage

- A2.1 Damage to the ecosystem (and its components) from deterioration or change in groundwater regimes must be avoided. The ecosystem components include:
- a) the physical-chemical environment; and
  - b) the community of organisms dependant on the system, some of which may be useful as early indicators of damage.
- A2.2 Significant Damage to ecosystems associated with GWDTE may be identified by the following:
- A2.2.1 For the Natura 2000 network (whether dependent on a body of groundwater identified under the WFD definition or not):  
For any groundwater dependent ecosystem designated under community legislation Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora and under Directive 79/409/EEC on the conservation of wild birds, the conservation value is expressed in terms of ensuring the site's contribution to the achievement of favourable conservation status (FCS) for the Natura 2000 network.
- a) 'Significant damage' (as meant by Article 4 1b) is therefore occurring if the site fails to achieve any of the conservation objectives (favourable condition) established due to the failure to provide groundwater conditions that are necessary to support the achievement of conservation objectives for the GWDTE.

- b) For ecosystems that are covered by statutory designations, the avoidance of damage from groundwater related factors that prevents the ecosystem from achieving its conservation value can be judged as fulfilling the requirements of Article 4.

A2.2.2 For non-Natura UK statutory sites (i.e. UK BAP priority habitats):

- a) 'significant damage' equates to the failure to achieve conservation objectives ensuring the contribution to the UK network of nationally designated sites due to groundwater related factors.

#### **UK BIODIVERSITY ACTION PLAN PRIORITY HABITATS**

The Convention of Biological Diversity was signed in June 1992 by 159 Governments at the Rio Earth Summit, and entered into force on 29<sup>th</sup> December 1993. It provides a legal framework for the conservation of biological diversity and represents a significant Government commitment. The UK Biodiversity Action Plan was launched in 1994, and identifies species and habitats of conservation concern within the UK (i.e. species and habitats of national importance). Each habitat and species has a national costed action plan, with specific projects and targets.

Reporting occurs at intervals (1999, 2002) and includes information on condition and trends, progress towards targets and the identification of any obstacles. However, there are no legally binding requirements, and therefore no penalties for not meeting the targets. Equally, there is no funding or resource allocated to the achievement of the targets.

Relevant habits that are usually or may be groundwater fed include:

- Aquifer fed naturally fluctuating water bodies (turloughs and meres; both very rare habitats)
- Coastal and floodplain grazing marsh (more usually dependant upon surface water levels)
- Coastal salt marsh (ditto)
- Coastal sand dunes (sand dune slacks are usually groundwater dependant)
- Fens (usually groundwater dependant)
- Lowland heathland (wet heaths will be usually fed by groundwater)
- Lowland meadows (more likely to be dependant on flooding regime, but may be GWD, especially at certain times of year)
- Raised bog (usually dependant on high groundwater table and/or low permeability substrate)
- Purple moor grass and rush pasture (usually dependant on poor drainage and high rainfall)
- Wet woodland (usually occur on poorly drained seasonally flooded land, but also on flushes within fens, mires and bogs)

## Annex 3:

### Generic information on particular wetland species and habitat types.

<a href="#">Water Resources &amp; Conservation: A Framework for the assessment of the Hydrological Requirements of habitats and species</a>
Section 2.2.3 – Temperate heath, Scrub & Grassland
<ul style="list-style-type: none"><li>• Temperate wet heaths with <i>Erica ciliaris</i> and <i>Erica tetralix</i></li><li>• Northern Atlantic wet heaths with <i>Erica Tetralix</i></li><li>• <i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinia caerulea</i>)</li></ul>
Section 2.2.4 – Raised bogs, fens, mires, alluvial forests and bog woodland
<ul style="list-style-type: none"><li>• Raised bog (ombotrophic bog)</li><li>• Blanket Bogs</li><li>• Transition mires and quaking bogs</li><li>• Depressions on Peat Substrates of the Rhynchosporion</li><li>• Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion <i>davallinae</i></li><li>• Petrifying springs with tufa formation (Cratoneurion)</li></ul>
<ul style="list-style-type: none"><li>• Alkaline Fens Calcium rich springwater fed fens</li><li>• Alpine pioneer formations of the Caricion <i>bicoloris-atrofuscae</i></li><li>• Bog Woodlands</li><li>• Alluvial forest with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i></li></ul>
Section 2.3.1 – Invertebrates (may be good indicators of groundwater levels)
<ul style="list-style-type: none"><li>• Whorl Snails (Geyer's, narrow-mouthed, round-mouthed, Desmoulin's)</li><li>• Southern Damselfly</li><li>• Marsh Fritillary</li></ul>
Section 2.3.2 – Amphibians
<ul style="list-style-type: none"><li>• Great Crested Newt</li></ul>
Section 2.3.4 – Plants
<ul style="list-style-type: none"><li>• Slender green-feather moss</li><li>• Marsh Saxifrage</li><li>• Creeping Marshwort</li><li>• Fen orchid</li></ul>
Section 2.3.5 SPA Birds
<b>Ecohydrological guidelines for lowland wetland plant communities</b> <a href="http://publications.environment-agency.gov.uk/epages/eapublications.storefront">http://publications.environment-agency.gov.uk/epages/eapublications.storefront</a> Type "eco-hydrological guidelines" into the search box.
<ul style="list-style-type: none"><li>• Introduction and Structure</li><li>• Lowland Wet Grassland community guidelines (inc. MG4, MG8, MG13)</li></ul>
<ul style="list-style-type: none"><li>• Fen/Mire community guidelines (M13, M24, S2, S24, PPc (<i>Peucedano-Phragmitetum-caricetosum</i>) Community)</li><li>• Ditch and Swamp communities (A3, A4, A9, S4, S5)</li></ul>
<b>EN/CCW project on Wet heaths and Wet Woodland</b> English Nature Research Report 619 (Wet Woodland) and 620 (Wet Heath) available as .pdf files from: <a href="http://www.english-nature.org.uk">www.english-nature.org.uk</a>
<ul style="list-style-type: none"><li>• Northern Atlantic wet heaths with <i>Erica tetralix</i> (H5, M14, M15, M16)</li><li>• Southern Atlantic wet heaths with <i>Erica ciliaris</i> and <i>Erica tetralix</i> (H3, H4, M16, M21)</li><li>• Residual alluvial forests (<i>Alnion glutinoso-incanae</i>) (W5, W6, W7)</li><li>• Bog woodland (M18, M19, W4)</li></ul>
<b>Wetland Framework Extension:</b> M4, M5, M9, M10, M13, M14, M21, M18, M29, S25c, S27 A <i>Wetland Framework For Impact Assessment At Statutory Sites In Eastern England.</i> Environment Agency, R&D Note W6-068/TR1 and W6-068/TR2, Wheeler, B.D. & Shaw, S.C. (2001) <a href="http://publications.environment-agency.gov.uk/epages/eapublications.storefront">http://publications.environment-agency.gov.uk/epages/eapublications.storefront</a> Type "wetland framework" into the search box.

**Annex 4: Generic Checklist for GWDTE Investigations on sites requiring investigation as part of significant damage assessments – GROUNDWATER parameters (refer to UKTAG Guidance 12a Chapter 2 for general principles governing groundwater monitoring for WFD)**

	<b>Measurement</b>	<b>Justification</b>
1	Establishment of a reference quadrat in each distinct ecological feature	For monitoring long-term ecological condition of feature to demonstrate 'no deterioration', or otherwise
2	Dipwell in main habitat features, with a fixed datum (unaffected by seasonal peat movements). Dipwells (or some other mechanism) should record the elevation of the water table. Instruments may need to be nested to track the range of variation.	Establish groundwater level in direct contact with feature
3	Shallow piezometer in significant sand/gravel layers beneath site	Establish groundwater level in permeable materials between main aquifer and superficial deposits
4	Observation point in regional aquifer beneath site	Establish water level in aquifer from which consented abstractions take place. More than one well may be needed where there is more than one aquifer, or where there is reason to believe that the aquifer is heterogeneous
5	Deep observation point located at the stratigraphically equivalent depth to the main abstraction horizon.	Measurement of water level in the horizon most likely to be affected by consented activities. Establish full vertical gradient
6	Network of regional observation wells, at least 3 distributed around the site within 5 km, and operational.	Sufficient to establish basic calibration of a regional model in the vicinity of the site, and to determine regional flow direction.
7	Nest of observation points within the expected cone of depression of large consented borehole abstractions, e.g. Public Water Supply	Characterise hydraulic signal from consented source, so that it can be recognised and also so that rate of dissipation can be assessed.
8	Where a small number of large abstractions is concerned, observation points in the vicinity of the abstractions. e.g. groups of spray irrigators.	Needed to identify as clearly as possible the signal produced in the aquifer by the consented abstraction, as standard pumping test practice.
9	Stage measurement in drains and other surface watercourses likely to affect site water level	Drains likely to be critical in controlling site water level.
10	Flow measurement - provides information on water balance, and may also be important in maintaining the extent of the wet area. For some sites, flow velocity may be important to the ecology directly	Flow is likely to be more sensitive to consented abstractions than is water level.
11	Skeleton topographic survey, linking habitat features, measurement points and hydraulic controls, e.g. sluices.	It is critical for the water levels in the various units to be related to a common datum, so that gradients and controls can be determined.
12	Pumping signal monitoring / pumping test	Special operation of the consented source to generate a long period signal most likely to be detected, within the site
13	Continuous monitoring for 1 year. Monitoring should include qualitative observations (e.g. of site wetness) as well as instrumental readings.	1 year is the minimum to capture the annual cycle. Continuous monitoring of water levels yields much clearer information and thus facilitates the identification of pumping signals
14	Augering to determine geology of the bed of the wet area (geophysics possible alternative)	Knowledge of the connection between the wetland and deeper aquifers is critical to understanding wetland behaviour.
15	Hydrochemical survey if ecology suggest water chemistry is important (salinity/nutrient status/alkalinity)	To quantify extent of distinctive chemistry and identify changes.



## List of abbreviations

ASSI	Area of Special Scientific Interest (Northern Ireland)
CCW	Countryside Council for Wales
EA	Environment Agency
EMCAR	Environmental Monitoring Classification Assessment and Reporting
EN	English Nature
FCS	Favourable Conservation Status
GWDTE	Groundwater Dependent Terrestrial Ecosystem
GWTT	Groundwater Task Team (UK Technical Advisory Group)
HD	Habitats Directive
NVC	National Vegetation Classification
RoI	Republic of Ireland
SAC	Special Areas of Conservation
cSAC	Candidate Special Area of Conservation
SNIFFER	Scotland and Northern Ireland Forum For Environmental Research
pSPA	Proposed Special Protection Area
SPA	Special Protection Areas
SSSI	Sites of Special Scientific Interest
UK BAP	United Kingdom Biodiversity Action Plan
UKTAG	UK Technical Advisory Group
WETMEC	Wetland water supply mechanism
WFD	Water Framework Directive
WTT	Wetland Task Team (UK Technical Advisory Group)